INSTRUCTIONS FOR USING THE 7/1/08 CSD DUCT BLASTER & BLOWER DOOR DATA SHEET

1. INTRODUCTION

In addition to explaining the Data Sheet, this handout provides user-friendly tips on performing pressure diagnostics with a Minneapolis Duct Blaster® and Blower Door™.

1.1. PURPOSE

These instructions explain the proper use of the CSD 7/1/08 "Duct Blaster & Blower Door Data Sheet". It is important that the Data Sheet be filled in properly and completely, because it provides a:

- Convenient system for tracking incremental results.
- Simple method for keeping the crew aware of how close they are to Economic Stop.
- Permanent record of Duct Blaster and Blower Door work performed.
- Reference for use by weatherization inspectors.

The Data Sheet is laid out in a one-sheet, two-sided format. It is best to duplicate it on a single piece of paper, to keep all the information together on one sheet.

1.2. GENERAL INSTRUCTIONS

When completing the Data Sheet, be neat, accurate, complete.

1. Use a pen or sharp pencil (mechanical pencil recommended).
2. Print neatly. Use block or capital letters, not cursive writing.
3. Open-top boxes are used to record a quantity, a name, etc. Numbers and letters are entered in open-top boxes.
4. Closed boxes are used to select an answer. Completely fill in the box ■ or place an "X" inside ☒. Do not use check marks.
5. When writing on a blank line ("Describe", "Comments", etc.), be brief, clear and concise.
6. All applicable sections must be properly filled in, and the completed Data Sheet must be dated and signed by the Crew Leader.

Two sets of illustrative pages appear at the end of this handout (Sec. 4.).

- First is a blank Data Sheet containing large circled numbers, which is a reference for the numbered instructions [(1), (2), etc.] in this guide.
- Next is a completed "Example" Data Sheet, which shows how to fill out the form. It illustrates the "Example of Incremental Duct Work" described in Section 3.2.

2. SIDE 1 OF THE DATA SHEET

Side 1 provides a summary of customer, structural, and diagnostic data. Descriptions of "incremental" work performed and progress test results are entered on Side 2.

2.1. STATISTICAL INFORMATION

(1) Contractor Name and Address

Before this form is copied for field use, this information should be typed onto the "reproduction master". Then, all copies for use in the field will already contain contractor identification.

2.1. STATISTICAL INFORMATION (CONT'D)

(2) Customer Name and Address

Enter the name of the customer who occupies the home (the person receiving weatherization) and the street address where services are provided.

(3) Customer Telephone Number

Enter the area code and number for the home being weatherized. If there is a message phone, or if there is a contact person other than the occupant (such as the landlord) who is responsible for approving work or scheduling work and inspections, enter that phone number. Also include the contact person's name and a brief explanatory note.

(4) Unit

Enter the apartment number or letter that identifies this home. Leave blank if no unit number exists. Must be completed for: (a) dwellings in a building with multiple units, and (b) a single family home when two dwellings are served by one meter.

2.2. HOUSE CHARACTERISTICS

These fields for "Type of Structure" (5) and "Wall Type" (6) are divided by a horizontal dashed line. Items *above* the line apply to *conventional* houses. Items *below* the line apply to *mobile* homes.

(5) Type of Structure

a. For **conventional homes**, fill in or mark a box for Single Family or Multi-family, and enter the number of stories (*Single Family* homes only). On the "Slab %" line, write the percentage of the floor area that is slab-on-grade. (A good *estimate* is adequate. Enter "0" for raised foundations.)

b. For **mobile homes**, fill in or mark a box (below the dashed line) to indicate the width of the unit (single- or double-wide).

(6) Wall Type

a. For **conventional houses**, mark the "Wood Frame" box for all homes with wood frame construction, regardless of the exterior finish.
   - For a home with *more than half of the total wall area* constructed of cement blocks, adobe, solid brick, etc., mark "Masonry".
   - For a home with a combination of construction styles, mark the category which describes the *greatest percentage of the structure.* For example, if a wood frame stucco home has just a living room wall that is solid block or brick, mark "Wood Frame" for wall type.
   - If *more than half* the total wall area is solid block or brick, mark "Masonry" for wall type.

b. For **mobile homes**, mark the box (below the dashed line) which describes the exterior siding: "Metal" or "Non-metal" (anything other than metal, such as wood siding, is Non-metal).

(7) Heating System Type

Mark a box for *each type* of heating appliance or system present in the home. Do not write in the *number* of appliances, if there are two or more of the *same* type.

a. If there are more than one *type*, mark (or fill in) the box for *each* type.

2.2. HOUSE CHARACTERISTICS (CONT'D)

b. If there are two of a given type of appliance (such as two wall furnaces), simply fill in or mark an "X" in the box for that type of appliance. Do *not* write in a number to indicate how many of that appliance are present.

c. Do not mark a box for a heating appliance or system which has been disconnected and abandoned.

(8) Heating Fuel Type

Mark a box for *each type* of heating fuel for which the home is equipped. If, for example, wood is used but an operable natural gas furnace is present, mark *both* boxes. [The *primary* fuel type is used in CSD WIS Appendix A to determine ESP.]

(9) Cooling System Type

Mark a box for *each type* of cooling appliance or system present in the home. ("WHF" stands for "Whole House Fan".)

(10) DB & BD Wx Dates

To document the date and duration of each Duct Blaster and/or Blower Door work session, three fields are provided. For each work session/day, fill in one field. If both Duct Blaster and Blower Door work occur in the same dwelling, use a separate date/time field for each session/category.

a. On the "Date" line, write in the date DB/BD activities occurred.

b. On the "Type Work", line circle "DB" for Duct Blaster or "BD" for Blower Door.

c. On the "Start" and "End" lines, enter the applicable times (the time DB or BD work started and the time it ended) ... and circle either "am" or "pm".
   - If **work is not interrupted** (is completed in one continuous time block), fill in both "Start" and "End" times plus "Total Hours".
   - If **work is interrupted** (done in two or more *separate* time blocks on the same day), fill in only the "Start" time plus "Total Hours".

d. On the "Total Hours" line, write the actual number of hours devoted to DB/BD activity on the date listed. Round to the nearest quarter-hour (i.e., "0.25", "0.50", "0.75", etc.). [Up to 22 minutes is "0.25" Hr., 23 to 37 minutes is "0.5" Hr., and so on.]

2.3. PROGRAMMATIC DATA

MVR Field for Blower Door Diagnostics [Items (11) to (14)]

This is vitally important information for Blower Door-guided shell sealing, as it is the basis for determining **how tight the home may be sealed.** It is here that the "Minimum Ventilation Requirement" (MVR) is determined and recorded. MVR is also the "Shell Target"—which is the amount of shell leakage that must remain after sealing work is completed.

(11) Living Area (sq. ft.)

This is the total square footage of the *conditioned* space. Use *exterior* dimensions and *round to the nearest whole foot* (i.e., 41'-5" is 41', and 41'-6" is 42').

- Measurements may be taken on the inside of the home, but wall thickness must be added (so the wall lengths recorded are the same as if they had been measured on the outside).
- For split level or multi-story homes, use the *total* square footage of *all* living areas—the downstairs floor space plus the upstairs floor space.

2.3. PROGRAMMATIC DATA (CONT'D)

(12) Total Number of Occupants

This is the number of adults and children (including babies and infants) who live and sleep in the conditioned space plus the number of *large pets* that live in the home or sleep indoors at night.

- Typically, pets counted as "occupants" are *dogs of medium size or larger* (knee high or taller). Do not count cats, hamsters, birds, etc.
- When counting people, do not include temporary house guests nor persons who are there only during a portion of the day (e.g., children attending a daycare home).

Example: In a home with two parents, two children, and a medium size live-in dog, there are a total of five "occupants". Even if the home were used as a daytime child care center, with ten more children present in the home during the day, the number of occupants is still five.

(13) Open Combustion Input Rating Total

Enter the sum of Btu/hr input ratings for Open Combustion appliances that *draw combustion air from the conditioned space.*

- Include in this calculation central furnaces, wall furnaces, free-standing heaters, water heaters, cook stoves, ovens, and clothes dryers—if they are inside the living space or draw combustion air from the living space. (This calculation is *different from the calculation for CVA*, which does *not* include *cook stoves* and *ovens*.)
- Exclude the following Open Combustion appliances: (a) floor furnace drawing combustion air from under the house, (b) appliances located in an interior enclosure that are isolated from the living space (i.e., appliance draws combustion air from outdoors and enclosure door is weatherstripped), and (c) appliances located in the garage or elsewhere outside the conditioned living space.
- Exclude Closed Combustion furnaces, such as mobile home furnaces, and direct-vent wall furnaces drawing outdoor air through a horizontal multi-wall flue pipe.

(14) MVR (Shell Target)

Applying the information recorded in Items (11) through (13), use CSD WIS Appendix F, "Minimum Ventilation Requirement ("Shell Target"), to determine MVR [Item (14)]. Because Target specifies how tight the house may safely be sealed, it is essential that all information gathered for this section be accurate and properly applied in Appendix F. Air sealing measures which will bring the home *below* MVR/Target must not be installed.

ESP and Start/Stop Fields

Addressing both Duct and Shell Sealing, fields (15) & (16) are equally important for determining and recording the "Economic Stop Parameters" (ESP) for Duct Sealing and Shell Sealing.

(15) # of Crew Persons

In this open-top box, enter the *number* of persons performing Duct Testing & Sealing and Blower Door Testing & Sealing. **If the crew size changes during the job:**

a. The change must be noted on Side 2 in the incremental work section (2nd Work, 3rd Work, etc.) where the change occurs, and

b. The ESP for the new crew size must be noted and used from that point forward.

2.3. PROGRAMMATIC DATA (CONT'D)

(16) Reduction Required per Clock Hour per Crew

Use CSD WIS Appendix A to determine the ESP values for Duct Sealing and for Shell Sealing. Each of these numbers is the amount of $CFM_{25/50}$ leakage reduction the crew must achieve in an hour in order for air sealing work to be cost effective.

- *Note: Until CSD WIS Appendix A is revised with separate ESP criteria for ducts (CFM_{25}) and shell (CFM_{50}), use the existing CFM_{50} criteria for both duct and shell sealing.*
- There is a set of tables for Duct Sealing and another set for Shell Sealing. Each set is subdivided for crew size (one, two, or three persons). Each table list counties and fuel types. Follow instructions for using CSD WIS Appendix A (provided on pages A-1 and A-2 of the Appendix).
- The ESP figures given in Appendix A are for **one full hour** of work. For a **half-hour increment,** the ESP is **divided in half**. For example, if the **one hour** ESP is **100** $CFM_{50/25}$, the **half-hour** ESP is **50** $CFM_{50/25}$ (100/2 = 50).

(17) Duct Blaster Location and Start/Stop CFM_{25}

Indicate the location where the Duct Blaster was connected to the duct system. This information will be used by inspection personnel to accurately duplicate crew testing. Using CSD WIS Appendix A and Appendix J, calculate the Duct Sealing Start CFM_{25} (14% of system airflow + 1-hour ESP) and Stop CFM_{25} Target (14% of system airflow), and enter those figures in the blanks provided.

(18) Blower Door Location and Start/Stop CFM_{25}

Indicate the doorway in which the Blower Door was placed during weatherization. This information will be used by inspection personnel to accurately duplicate crew testing. Using CSD WIS Appendix A, calculate the Shell Sealing Start CFM_{50} (which is MVR + 1-hour ESP), and enter it in the blank provided. For Shell Sealing, the Stop/Target CFM_{50} is simply MVR, which has already been determined and entered in the blank above [see (14)].

2.4. PRE-WX AND POST-WX TESTS

Fields (19) and (20) are used to record information about diagnostic tests conducted: (a) prior to performing sealing work, and (b) following completion of sealing work.

(19) PRE-Wx Tests

Record the test date and whether it is Duct Blaster or Blower Door Testing. For Blower Door Testing, also record the outdoor temperature (preferably in the shade) and wind speed. If "windy", *estimate* the wind speed. This information will be used by inspection personnel.

(20) POST-Wx Tests

When conducting Post-Wx Tests after sealing work is completed, this field is completed the same way the one above was for Pre-Wx Tests.

2.5. DUCT BLASTER DUCT TESTING

Fields (21) to (23) are used to record test data for Duct System Testing/Diagnostics using a Duct Blaster. *Note that all Duct Leakage Testing is performed with a Duct Blaster—and the "subtraction method" using a Blower Door is no longer allowed.*

2.5. DUCT BLASTER DUCT TESTING (CONT'D)

(21) Duct Blaster Duct Pre-Test

In this field, record information about Pre-Weatherization Duct Testing.

- If this Duct Testing and Repair/Sealing is not subject to Title 24 requirements, mark the "CSD" box. If an HVAC "alteration" has been performed and this Duct Testing and Repair/Sealing is subject to Title 24 requirements, mark the "T-24" box. [See Item (31)3. on page 9 for more on Title 24 requirements.]
- Following completion of the first (Initial) duct test, record CFM_{25} duct leakage in the blank labeled "Initial Duct Leakage (A)".
- Circle the number describing Fan Configuration used for the test ("O" for Open Fan, "1" for Ring 1, etc.)
- Indicate whether ducts were Pressurized (standard procedure) or Depressurized.
- If Initial Duct Leakage is so great that a Duct Pressure of 25 Pa cannot be achieved, mark the "Can't Reach Pressure" box and record the maximum duct pressure reached in the space provided below.

(22) Duct Blaster Duct Post-Test

Following completion of Duct Testing and Sealing, record information about Post-Weatherization Duct Testing, in a manner similar to that described in Item (21) for the Pre-Wx Test.

(23) Duct Leakage Reduction

Use this field to record final Duct Sealing statistics.

- In the blanks provided, record the "Initial Duct Leakage (A)" and "Final Duct Leakage (B)".
- Calculate and record "Total Reduction (C)". Subtract "Final Duct Leakage (B)" from "Initial Duct Leakage (A)". [For example, if Initial Duct leakage (A) is 300 CFM_{25} and Final (B) is 100, Total Reduction (C) is 200 CFM_{25} (300 – 100 = 200).]
- Calculate and record "% Reduction (D)". Divide "Total Reduction (C)" by "Initial Duct Leakage (A)" and multiply by 100. [Because Initial Duct leakage (A) was 300 CFM_{25} and Total Reduction (C) is 200 CFM_{25}, % Reduction (D) is 66.7% (200/300 x 100 = 66.7%).]

2.6. BLOWER DOOR SHELL TESTING

Fields (24) to (26) are used to record test data for Shell Testing/Diagnostics using a Blower Door. *Remember that a Blower Door is used to measure Shell Leakage only (all Duct Leakage Testing must be performed with a Duct Blaster).*

(24) Blower Door Shell Pre-Test

- **Ducts Present?** If ducts are present in the home, circle "Y". If ducts are not present, circle "N". Note: If ducts are present, all supply registers and return grilles must be and blocked off for Shell Leakage Testing.
- Following completion of the first pressure test, record CFM_{50} shell leakage in the blank labeled "Initial Shell Leakage (E)".
- Circle the letter describing Fan Configuration used for the test ("O" for Open Fan, "A" for Ring A, etc.)
- Indicate whether the house was Pressurized or Depressurized.
- If Initial Shell Leakage is so great that a House Pressure of 50 Pa cannot be achieved, mark the "Can't Reach 50" box and record the maximum House Pressure reached in space provided below.

2.6. BLOWER DOOR SHELL TESTING (CONT'D)

(25) Blower Door Shell Post-Test

Following completion of Shell Testing and Sealing, record information about Post-Weatherization Shell Testing, in a manner similar to that described in Item (24) for the Pre-Wx Test.

(26) Shell Leakage Reduction

Use this field to record Final Shell Sealing statistics.

- In the blanks provided, record the "Initial Shell Leakage (E)" and "Final Shell Leakage (F)".
- Calculate and record "Total Reduction (G)". Subtract "Final Shell Leakage (F)" from "Initial Shell Leakage (E)". [If Initial Shell Leakage is 2,000 CFM_{50}, and Final Shell Leakage is 1,500, Total Reduction is 500 CFM_{50} (2,000 – 1,500 = 500).]

2.7. CREW VERIFICATION

It is important to have a record of persons who worked on the job, for the company's sake and for use by inspection personnel. Fill in this section upon completion of DB/BD work.

(27) Crew Identification, Signature, and Completion Date

- Enter the last name and first initial of each crew member who participated in testing and sealing for ducts and/or shell.
- The crew leader's signature is required to verify that all work was performed in accordance with program procedures and installation standards.
- Also enter the date work was completed

3. SIDE 2 OF THE DATA SHEET

This side is used to record information about: (a) the duct system and Duct Testing, Repair and Sealing, and (b) about the shell and Shell Testing and Sealing.

(28) Start Side 2 by writing the customer's name and city in the box at the top. This is very important, in case Sides 1 and 2 are ever duplicated on separate sheets of paper.

3.1. DUCT LEAKAGE SEALING

The upper half of the page is divided into several subsections [Items (28) to (31)] for recording information about the duct system, sealing work, and leakage reductions.

(29) Date and Crew Persons

Enter the date Duct Sealing work is performed and number of crew persons working.

- If work is done on more than one day, or if the number of crew persons changes during the process, those facts must be noted in the incremental data section where they occur.
- When the crew size changes, the Economic Stop Parameters applicable to the new crew size must be used from that point forward.

3.1. DUCT LEAKAGE SEALING (CONT'D)

(30) Types of Ducts

Mark a box for *each* of the duct "Types" present, using as many boxes as necessary.

- Use the comment field to note information about other materials, etc.
- If a material is suspected of being **asbestos**, work must not be done which will disturb it; and its presence must be recorded in the "Hazardous Materials" data field further down the page [Item (31)].

(31) Duct Sealing "Incremental Work" Completed

Use the four sections provided to concisely describe work performed and leakage reductions achieved (see Sec. 3.2., "Example of Incremental Duct Work" for guidance). This process determines when Target is reached or the Economic Stop Policy is met. The information will be used by inspection personnel to evaluate the Data Sheet and the job. (Remember, *open-top* boxes are for *numbers*, not an "X".)

1. **"1st Work"**

   This is the first increment of work completed.

   a. On the blank lines, briefly describe the types of repair/sealing work done during this increment. If room allows, also indicate the types of materials used.
   b. **"Pre CFM25"** is the duct leakage that existed before work began. It should be the same as "Initial Duct Leakage (A)" on side 1.
   c. **"Post CFM25"** is the duct leakage measured after the 1st work is completed.
   d. **"Reduction"** is the change in duct leakage determined by subtracting "Post CFM25" from "Pre CFM25". This tells the crew how much leakage reduction has been achieved during that increment of work.
      - If the CFM25 reduction is *greater than* the ESP (and leakage is still above Target), the crew continues working.
      - If the CFM25 reduction *is less than* the ESP, the Economic Stop Policy has been met and the crew stops Duct Sealing. [Reaching Target also stops Duct Sealing, as explained below in Item (31)2. on page 9.]
   e. **"Clock Hours"** means the length of time (# of hours) worked by the crew during the increment, recorded in decimal fractions in the "Clock Hrs" box.
      - It is not necessary for a work increment to be a full hour, so this entry might be "0.25", "0.5", "0.75", etc.
      - Time is rounded to the *nearest quarter hour.*
      - For example, up to 22 minutes is recorded as "0.25" (quarter hour); 23 to 37 minutes is rounded to "0.5" (half hour), and so forth.

2. **"2nd Work" – "4th Work"**

   The number of increments of work performed will vary depending on how high above Target the Initial Duct Leakage is, types of defects causing the leakage, accessibility, etc.—and how quickly Target is reached. [For more about recording incremental work, see Sec. 3.2., "Example of Incremental Duct Work", on page 10.]

   a. Complete these fields as described above for "1st Work".
   b. For each work increment, the "Pre CFM25" is always the last reading taken *before* the increment began. Thus, the "Post CFM25" from 1st Work is the "Pre CFM25" for 2nd Work, and so on.

(31) Duct Sealing "Incremental Work" Completed (cont'd)

3. **"Work Increment" Length**

The length of time spent on a work increment is essentially a matter of good judgment, although progress should normally be checked at least once an hour.

- CSD WIS "Appendix A" lists "Economic Stop Parameters" for one-hour work increments, but it is not necessary to work a full hour between progress tests.
- If it appears that a lot of leakage was sealed in the first *half*-hour, that might be a logical time to re-check leakage. If good progress was made, that concludes "1st Work", and the crew begins "2nd Work".
- If, in "2nd Work", leakage reduction is slowing down due to fewer sealing opportunities, a progress check should be made after a relatively short time (e.g., 15 to 30 minutes).

(32) Hazardous Materials, Target, and ESP

1. **Hazardous Materials**

Presence of hazardous materials and their locations must be recorded by marking the appropriate boxes. Explanatory comments are very helpful. Policies on hazardous materials include the following:

- Crews sealing ducts may handle only:
  (a) duct system components and insulation made of rigid metal, flexible metal, flexible plastic, and rigid and flexible fiberglass, and
  (b) construction materials (such as wood, gypsum, and sheet metal) used in platform returns and structural cavities serving as ducts.
- *Unless determined safe by a qualified expert, other materials shall be considered hazardous and must not be disturbed by the crew.*

2. **Target Reached?** and **Economic Stop Reached?**

- Always indicate whether: (a) Duct Sealing Target (Stop CFM25) was reached, and (b) Economic Stop Policy requirements were met. Add comments regarding problems encountered and reasons why Target or Economic Stop was not reached.
- **It is only necessary to reach either Target or ESP, whichever comes first.** Because Duct Sealing Target (Stop CFM25) is 14% of system airflow (not zero), it is quite possible to reach Target *before* reaching Economic Stop.

Example 1: Assume: (a) system airflow is 1,000 CFM, (b) **Initial** Duct Leakage is **200** CFM25, (c) **Target** is **140** CFM25 (14% of airflow), and (d) **ESP** is **40** CFM25. If **1st Work** produces a **60** CFM25 reduction, Duct Sealing **Target** of **140** CFM25 is reached, and the crew discontinues Duct Sealing. They stop, because Target is reached—even though 1st Work Reduction CFM25 (60) exceeds ESP (40).

Example 2: With the same CFM25 assumptions used in Example 1, if **1st Work** produces a **30** CFM25 reduction, Duct Leakage is now **170** CFM25. Target (**140** CFM25) is not reached—but Leakage Reduction (**30** CFM25) is *less than* Economic Stop (**40** CFM25), so Duct Sealing stops. *Exceptions for Title 24 jobs are explained next.*

3.1. DUCT LEAKAGE SEALING (CONT'D)

(32) Hazardous Materials, Target, and ESP (cont'd)

3. **Title 24 Duct Testing and Sealing Requirements**[1]

   Special Duct Testing and Sealing requirements apply to Conventional Homes when an HVAC system "alteration" occurs.[2]

   - Final Duct Leakage CFM25 must meet one of two primary goals:
     - Leakage reduced *to less than 15% of system airflow* (e.g. 14%), or
     - Leakage reduced *by more than 60% below pre-alteration leakage*, with smoke test and visual inspection by a HERS Rater. (Always perform a Duct Leakage test *before* an *alteration* takes place.)
   - If leakage reduction cannot feasibly meet either primary goal, then:
     - All *accessible* duct leaks must be sealed, with smoke test and visual inspection by a HERS Rater. (There is no CFM25 leakage or % limit.)
   - *CSD's Economic Start/Stop Policies do not apply to Title 24 jobs.*

3.2. EXAMPLE OF INCREMENTAL DUCT WORK

The following example illustrates how the "Duct Leakage Sealing" section on Side 2 of the Data Sheet is used and ESP checks are made for a "CSD" (not Title 24) job. The "Example" pages at the end of this document (Sec. 4., Item 2.) illustrate how to fill out the Data Sheet. [Shell Sealing is addressed in Sec. 3.3., "Shell Leakage Sealing".]

1. **Assume a 2-person crew** is working with the following factors:
   - **"Initial** Duct Leakage (A)" on Side 1 is **530 CFM25** (which is recorded as the **1st Work "Pre CFM25"** on Side 2),
   - System airflow is 1,000 CFM, so **Target** (14%) is **140 CFM25**, and
   - Duct **ESP** is **58 CFM25**. The crew must achieve at least that much Duct Leakage Reduction during the first hour's work to continue sealing ducts.
   - In Item (17) on Side 1, **Start** CFM25 is **198 CFM25** (140 + 58 = 198), which is Target plus one-hour ESP. **Stop** CFM25 (Target) is simply **140 CFM25** (14% of airflow).
2. **"1st Work"**
   - The crew works 65 minutes (considered "one hour") and seals the supply and return plenums and 5 wyes.
   - The work completed is itemized in the "1st Work" section of the Data Sheet, and "1.0" is recorded in the "Clock Hrs" box.
   - Assume the **1st Pre** CFM25 was **530**, and **1st Post** CFM25 is **330**. The **"Reduction"** is **200** CFM25 (530 – 330 = 200). This greatly exceeds the **1-hour ESP** of **58** CFM25 (and the remaining **330** CFM25 leakage is well above the **Stop CFM25/Target** of **140**), so Duct Sealing continues.

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[1] Title 24 Duct Testing and Sealing standards apply to Conventional Homes in California Energy Commission (CEC) Climate Zones 2 and 9–16. They do not apply to Mobile Homes.

[2] HVAC system "alterations" are: (a) installation or replacement of HVAC equipment [entire HVAC unit, or air handler, or outdoor condensing unit, or indoor evaporator coil, or furnace heat exchanger], or (b) installation or replacement of 40 or more feet of ductwork in unconditioned space.

3.2. EXAMPLE OF INCREMENTAL DUCT WORK (CONT'D)

3. **"2nd Work"**
   - The crew works another 55 minutes and seals several more joints.
   - They record one hour ("1.0" in the "Clock Hrs" box) and take another Duct Leakage measurement.
   - The **2nd Pre** CFM25 is **330** ("Post CFM25" from "1st Work"). The **2nd Post** CFM25 is **200**, so the **Reduction** is **130** CFM25 (330 – 200 = 130). That still exceeds the one-hour **ESP** of **58** CFM25 (and leakage is still above the **Stop CFM25/Target** of **140** CFM25), so duct sealing continues.
4. **"3rd Work"**
   - The crew works another 35 minutes sealing register boots.
   - They record a half-hour of work ("0.5" in the "Clock Hrs" box) and check Duct Leakage again.
   - The **3rd Pre** CFM25 is **200** (measured at the end of "2nd Work"). The **3rd Post** CFM25 is **175**, so the **Reduction** is **25 CFM25** (200 – 175 = 25).
   - The **one-hour ESP** is **58 CFM25**, but the crew worked for only a *half-hour*—so they divide the hourly ESP in *half* to calculate the **half-hour ESP**—which is **29 CFM25** (58/2 = 29). Since the **Reduction** of **25 CFM25** is *less than* **29**, the crew has satisfied the Economic Stop Policy.
   - The **3rd Post** CFM25 leakage of **175** is still above the **Stop CFM25/Target** of **140**. However, Duct Sealing requirements have been met on the basis of ESP, and the crew stops Duct Sealing and shifts attention to Shell Sealing.
   - Had this been a Title 24 job, however, the crew probably would continue trying to reduce Duct Leakage (see Item (31)3. on page 9).
   - Remember, for CSD (non-Title 24) jobs, *either* ESP or Target (whichever comes first) stops Duct Sealing. Had 3rd Work brought leakage *below Target*, Duct Sealing would stop—even though the Reduction would have been *greater than ESP.*

3.3. SHELL LEAKAGE SEALING

The lower half of Data Sheet Side 2 is divided into subsections [Items (32) to (35)] for recording information about Shell Sealing work performed. These fields are completed in much the same way the ones on the upper half of the page are for Duct Sealing (Sec. 3.1.).

(33) Date and Crew Persons

Same as Item (28) above, but entered for Shell Sealing.

(34) Thermal Bypasses Sealed

The term "thermal bypass" is used in this program to identify openings in the shell which may not always represent a large air leak but which contribute to thermal losses by means of "convective loops". Warmth moves from warm to cold through air in a hollow space; in un-insulated walls, warm air rises, cools, and falls again.

- Thermal bypasses can be bathtub holes (accessed through the crawlspace), wall cavities open to the attic (e.g., at dropped ceilings), wall cavities open to the crawl space (e.g., chaseways, balloon framed walls, etc.).
- In the open-top boxes, record the *number* of thermal bypasses sealed in each category. Also write relevant comments, especially when unusual circumstances are encountered.

3.3. SHELL LEAKAGE SEALING (CONT'D)

(35) Incremental Work Completed

- This item is completed in a manner similar to Item 30, but done for Shell Sealing.
- Note: When performing Blower Door-guided Shell Sealing in a residence with Shell Leakage *close to* MVR ("Shell Target"), take the following precautions:
  a. Monitor Shell Leakage carefully to make sure the house is not tightened below MVR. This may require a progress test after installation of each infiltration-reduction measure (rather than always after 30 or 60 minutes).
  b. Use temporary plastic blocking on items that have potentially large leakage (e.g., Evaporative Cooler vent), to make sure planned infiltration-reduction work (e.g., Cooler Vent Cover) will *not* tighten the Shell below MVR.
  c. If ducts are present, make sure all supply registers and return grilles are completely blocked/sealed during all tests. This prevents a false Shell Leakage reading that inadvertently includes some Duct Leakage—which can result in accidentally tightening the Shell below MVR.

(36) Target Reached? and **Economic Stop Reached?**

Indicate whether: (a) Shell Target CFM_{50} (MVR) was reached, and/or (b) requirements of the Economic Stop Policy were met. Also, write comments regarding problems encountered and reasons why Target was not reached.

4. SAMPLE DATA SHEETS

Following are two sample copies of the 7/1/08 CSD Duct Blaster & Blower Door Data Sheet:

1. **Data Sheet with Large Circled Numbers**
   This is the visual key corresponding to the items above with numbers in parentheses [(1), (2), etc.]. The circled numbers identify each portion of the Data Sheet discussed in this handout.
2. **The Completed Data Sheet Marked "Example"**
   This illustrates a properly-completed Data Sheet. Duct-related sections reflect data contained in the "Example of Incremental Duct Work" in Sec. 3.2. of this handout.

California Department of Community Services and Development (CSD)

DUCT BLASTER and BLOWER DOOR DATA SHEET

Contractor | Address (1)

Customer: Last Name (2) | First Name | Telephone Number ( ) (4) –

Customer: Street Address | Unit # (3) | City | ZIP Code

DB & BD Wx Dates

Date ____/____/____
Type Work: DB BD
Start:_____ am pm
End : _____ am pm
Total Hours:_____

(10)

Date ____/____/____
Type Work: DB BD
Start:_____ am pm
End : _____ am pm
Total Hours:_____

Date ____/____/____
Type Work: DB BD
Start:_____ am pm
End : _____ am pm
Total Hours:_____

Type of Structure
☐ Single Family ☐ Multi-family
Stories:____ (5) Slab:_____%
☐ Singe-Wide Mobile Home
☐ Double-Wide Mobile Home

Wall Type
☐ Wood Frame
☐ Masonry (6)
☐ Metal Siding
☐ Non-metal Siding

Heating System Type
☐ Wall ☐ Wood Stove
☐ Floor (7) ☐ Fireplace
☐ Gas FAU ☐ Heat Pump
☐ Other_____

Heating Fuel Type
☐ Natural Gas
☐ Electric (8)
☐ Propane ☐ Wood
☐ Other_____

Cooling System Type
☐ Central AC ☐ None
☐ Window/Wall AC (9)
☐ Evap Cooler ☐ WHF
☐ Other_____

MVR—Minimum Ventilation Requirement (Shell Target—Appendix F)

☐ Near/Below MVR—No Shell Sealing

Living Area (sq ft) (11) | # People | # Large Pets | + | Total # Occupants (12) | = | Open Combustion Input Rating (13) Btu/hr

Minimum Ventilation Requirement
MVR: (14) **CFM50** (Shell Target)

ESP—Economic Stop Parameters (Appendix A)

1-Hour ESP → **FAU System Airflow (Appendix J)** →
# of Crew Persons (15) → Reduction Required **per Clock Hour** for Crew (16)
Ducts _____ CFM25 **Shell** _____ CFM50

Duct Blaster Location & Start/Stop CFM25*

Start: (Airflow: (17) CFM) x (0.14 + 1-Hr ESP)
☐ Return Grille ☐ FAU/Air Handler Inlet
Start:_____CFM25 • **Stop:**_____CFM25 (Airflow x 0.14)

Blower Door Location & Start CFM50

☐ Front Door ☐ Back ☐ Side
☐ Other: (18)
Start:_____CFM50 (MVR + 1 Hr ESP) • **Stop:** MVR

PRE-Wx Tests Date: ____/____/_____
☐ Duct Blaster ☐ Blower Door
Outdoor Temperature: (19) °F
☐ Calm ☐ Windy: _____ mph

DUCT Pre-Test (Must use Duct Blaster) ☐ CSD ☐ T-24
Initial Duct Leakage **(A)** (21) CFM25
Fan Configuration: 0 1 2 3 ☐ "Can't Reach Pressure"
☐ Pressurized ☐ Depressurized • Max reached:_____Pa

SHELL Pre-Test (Must use Blower Door) • Ducts Present? Y N
Initial Shell Leakage **(E)*** (24) CFM50
Fan Configuration: O A B ☐ "Can't Reach 50"
☐ Pressurized ☐ Depressurized • Max reached:_____Pa

*All registers and grilles blocked, if ducts present

POST-Wx Tests Date: ____/____/_____
☐ Duct Blaster ☐ Blower Door
Outdoor Temperature: (20) °F
☐ Calm ☐ Windy: _____ mph

DUCT Post-Test (Must use Duct Blaster) ☐ CSD ☐ T-24
Final Duct Leakage **(B)** (22) CFM25
Fan Configuration: 0 1 2 3 ☐ "Can't Reach Pressure"
☐ Pressurized ☐ Depressurized • Max reached:_____Pa

SHELL Post-Test (Must use Blower Door)
Final Shell Leakage **(F)*** (25) CFM50
Fan Configuration: O A B ☐ "Can't Reach 50"
☐ Pressurized ☐ Depressurized • Max reached:_____Pa

*All registers and grilles blocked, if ducts present

DUCT LEAKAGE REDUCTION

Initial Duct Leakage **(A)** _____ CFM25 (A – B) = **Total Reduction (C)** _____ CFM25
Final Duct Leakage **(B)** _____ CFM25 (C/A) x 100 = **% Reduction (D)** _____ %

(23)

SHELL LEAKAGE REDUCTION

Initial Shell Leakage **(E)** (26) CFM50 (E – F) = **Total Reduction (G)**
Final Shell Leakage **(F)** _____ CFM50 **(G)** _____ CFM50

Last Name and First Initial of each Crew Member (27)

*Start/Stop formulas shown are for CSD jobs. For Title 24 standards see Appendix J, page J-7.

Crew Leader's Signature
X _____

Completion Date
____/____/_____

California Department of Community Services and Development (CSD)
DUCT BLASTER and BLOWER DOOR DATA SHEET

Customer Name: (28) **City:**

DUCT LEAKAGE SEALING* (29) # Crew Persons ☐

Date ____/____/____

Types: **FLEXIBLE:** ☐ Plastic ☐ Metal (30) **RIGID:** ☐ Metal ☐ Fiberglass ☐ Building Cavity ☐ Wooden Platform

Comments: _____

1st Work _____

Pre CFM25 ☐ **Post** CFM25 ☐ **Reduction** ☐ CFM25 Clock Hrs ☐.☐

2nd Work _____

Pre CFM25 ☐ **Post** CFM25 ☐ **Reduction** ☐ CFM25 Clock Hrs ☐.☐

(31)

3rd Work _____

Pre CFM25 ☐ **Post** CFM25 ☐ **Reduction** ☐ CFM25 Clock Hrs ☐.☐

4th Work _____

Pre CFM25 ☐ **Post** CFM25 ☐ **Reduction** ☐ CFM25 Clock Hrs ☐.☐

Hazardous Materials: ☐ Not present or ☐ Present in/on: ☐ Supply ☐ Return Comments: _____

Target reached? ☐ Yes ☐ No (32) **Economic Stop reached?** ☐ Yes ☐ No Comments: _____

SHELL LEAKAGE SEALING* (33) # Crew Persons ☐

Date ____/____/____

Thermal Bypasses Sealed: ☐ # Bathtub Holes, ☐ (34) # Wall Cavities, ☐ # Other: _____

Comments: _____

1st Work _____

Pre CFM50 ☐ **Post** CFM50 ☐ **Reduction** ☐ CFM50 Clock Hrs ☐.☐

2nd Work _____

Pre CFM50 ☐ **Post** CFM50 ☐ **Reduction** ☐ CFM50 Clock Hrs ☐.☐

(35)

3rd Work _____

Pre CFM50 ☐ **Post** CFM50 ☐ **Reduction** ☐ CFM50 Clock Hrs ☐.☐

4th Work _____

Pre CFM50 ☐ **Post** CFM50 ☐ **Reduction** ☐ CFM50 Clock Hrs ☐.☐

Target reached? ☐ Yes ☐ No • **Economic Stop reached?** ☐ Yes ☐ No Comments: _____

(36)

* **Testing with a DUCT BLASTER is required for DUCT Leakage Sealing. Testing with a BLOWER DOOR is required for SHELL Leakage Sealing.**

DUCT BLASTER and BLOWER DOOR DATA SHEET

Contractor: CONTRACTOR NAME | Address: CONTRACTOR ADDRESS

Customer: Last Name: CUZTAMUH | First Name: CATHY | Telephone Number: (123) 456-7890

Customer: Street Address: 123 ANY STREET | Unit #: A | City: ANY TOWN | ZIP Code: 90009

DB & BD Wx Dates

Date 6/23/08 — Type Work: (DB) BD — Start: 8:30 (am) pm — End: 11:30 (am) pm — Total Hours: 3.0

Date 6/23/08 — Type Work: DB (BD) — Start: 12:30 am (pm) — End: 3:00 am (pm) — Total Hours: 2.5

Date ___/___/___ — Type Work: DB BD — Start: ___ am pm — End: ___ am pm — Total Hours: ___

Type of Structure	Wall Type	Heating System Type	Heating Fuel Type	Cooling System Type
■ Single Family ☐ Multi-family	■ Wood Frame	☐ Wall ☒ Wood Stove (Primary Heat)	☒ Natural Gas	☒ Central AC ☐ None
# Stories: ___ Slab: ___ %	☐ Masonry	☐ Floor ☐ Fireplace	☐ Electric	☐ Window/Wall AC
☐ Singe-Wide Mobile Home	☐ Metal Siding	☒ (Not used) Gas FAU ☐ Heat Pump	☐ Propane ☒ Wood	☐ Evap Cooler ☒ WHF
☐ Double-Wide Mobile Home	☐ Non-metal Siding	☐ Other ___	☐ Other ___	☐ Other ___

MVR—Minimum Ventilation Requirement (Shell Target—Appendix F) ☐ Near/Below MVR—No Shell Sealing

Living Area (sq ft)	# People	# Large Pets	Total # Occupants	Open Combustion Input Rating	Minimum Ventilation Requirement
1500	2 +	1 =	3	80,000 Btu/hr	MVR: 1400 CFM50 (Shell Target)

ESP—Economic Stop Parameters (Appendix A)

1-Hour ESP → FAU System Airflow (Appendix J) →

# of Crew Persons: 2 — Reduction Required per Clock Hour for Crew: Ducts 58 CFM25 Shell 290 CFM50

Duct Blaster Location & Start/Stop CFM25*

Start: (Airflow: 1000 CFM) x (0.14 + 1-Hr ESP)

☒ Return Grille ☐ FAU/Air Handler Inlet

Start: 198 CFM25 • Stop: 140 CFM25 (Airflow x 0.14)

Blower Door Location & Start CFM50

☒ Front Door ☐ Back ☐ Side

☐ Other: ___

Start: 1690 CFM50 (MVR + 1 Hr ESP) • Stop: MVR

PRE-Wx Tests Date: 6/23/08

☒ Duct Blaster ☒ Blower Door

Outdoor Temperature: 78 °F

☒ Calm ☐ Windy: ___ mph

DUCT Pre-Test (Must use Duct Blaster) ☒ CSD ☐ T-24

Initial Duct Leakage (A): 530 CFM25

Fan Configuration: 0 (1) 2 3 ☐ "Can't Reach Pressure"

☒ Pressurized ☐ Depressurized • Max reached: ___ Pa

SHELL Pre-Test (Must use Blower Door) • Ducts Present? (Y) N

Initial Shell Leakage (E)*: 1975 CFM50

Fan Configuration: O (A) B ☐ "Can't Reach 50"

☒ Pressurized ☐ Depressurized • Max reached: ___ Pa

*All registers and grilles blocked, if ducts present

POST-Wx Tests Date: 6/23/08

☒ Duct Blaster ☒ Blower Door

Outdoor Temperature: 92 °F

☐ Calm ☒ Windy: 2-4 mph

DUCT Post-Test (Must use Duct Blaster) ☒ CSD ☐ T-24

Final Duct Leakage (B): 175 CFM25

Fan Configuration: 0 1 (2) 3 ☐ "Can't Reach Pressure"

☒ Pressurized ☐ Depressurized • Max reached: ___ Pa

SHELL Post-Test (Must use Blower Door)

Final Shell Leakage (F)*: 1525 CFM50

Fan Configuration: O (A) B ☐ "Can't Reach 50"

☒ Pressurized ☐ Depressurized • Max reached: ___ Pa

*All registers and grilles blocked, if ducts present

DUCT LEAKAGE REDUCTION

Initial Duct Leakage (A): 530 CFM25 — (A – B) = Total Reduction (C): 355 CFM25

Final Duct Leakage (B): 175 CFM25 — (C/A) x 100 = % Reduction (D): 67 %

SHELL LEAKAGE REDUCTION

Initial Shell Leakage (E): 1975 CFM50 — (E – F) = Total Reduction (G)

Final Shell Leakage (F): 1525 CFM50 — (G): 450 CFM50

Last Name and First Initial of each Crew Member

FOREMAN	I		
GOODMAN	M		

*Start/Stop formulas shown are for CSD jobs. For Title 24 standards see Appendix J, page J-7.

Crew Leader's Signature: x FOREMAN

Completion Date: 6/23/08

"EXAMPLE"

California Department of Community Services and Development (CSD)
DUCT BLASTER and BLOWER DOOR DATA SHEET

"EXAMPLE"

Customer Name: CUZTAMUA, C **City:** ANY TOWN

DUCT LEAKAGE SEALING*

Date 6/23/08 | # Crew Persons: 2 | Types: **FLEXIBLE:** ☒ Plastic ☐ Metal • **RIGID:** ☒ Metal ☐ Fiberglass ☐ Building Cavity ☐ Wooden Platform

Comments: SUPPLY RETURN

1st Work SEALED SUPPLY & RETURN PLENUMS AND 5 WYES

Pre CFM25: 530 | Post CFM25: 330 | Reduction: 200 CFM25 | Clock Hrs: 1.0

2nd Work SEALED 5 ELBOWS, 6 JOINTS, AND 10 BOOT CONNECTIONS + RETURN CAN

Pre CFM25: 330 | Post CFM25: 200 | Reduction: 130 CFM25 | Clock Hrs: 1.0

3rd Work SEALED 8 REGISTER BOOTS

Pre CFM25: 200 | Post CFM25: 175 | Reduction: 25 CFM25 | Clock Hrs: 0.5

4th Work

Pre CFM25: | Post CFM25: | Reduction: CFM25 | Clock Hrs: .

Hazardous Materials: ☒ Not present or ☐ Present in/on: ☐ Supply ☐ Return Comments:

Target reached? ☐ Yes ☒ No • **Economic Stop reached?** ☒ Yes ☐ No Comments: ACCESS TO SOME AREAS UNDER HOUSE TIGHT. SOME JOINTS COULD NOT BE REACHED.

SHELL LEAKAGE SEALING*

Date 6/23/08 | # Crew Persons: 2 | Thermal Bypasses Sealed: 2 # Bathtub Holes, 2 # Wall Cavities, ___ # Other:

Comments: 2ND BATHTUB HOLE DIFFICULT TO ACCESS, SEALED MANY PLUMB. PENETRATIONS.

1st Work SEALED 2 BATHTUB HOLES, 8 PLUMBING PENETRATIONS IN CRAWLSPACE + 4 IN ATTIC. SEALED 2 DROPPED CEILING CAVITIES, 6 INTERIOR PLUMBING PENETRATIONS, W/S ATTIC ACCESS, INSTALLED RANGE HOOD DAMPER.

Pre CFM50: 1975 | Post CFM50: 1625 | Reduction: 350 CFM50 | Clock Hrs: 1.0

2nd Work CAULKED AROUND FIREPLACE, 2 DOORS, AND 3 WINDOWS. W/S 1 DOOR.

Pre CFM50: 1625 | Post CFM50: 1525 | Reduction: 100 CFM50 | Clock Hrs: 0.5

3rd Work

Pre CFM50: | Post CFM50: | Reduction: CFM50 | Clock Hrs: .

4th Work

Pre CFM50: | Post CFM50: | Reduction: CFM50 | Clock Hrs: .

Target reached? ☐ Yes ☒ No • **Economic Stop reached?** ☒ Yes ☐ No Comments: COULD HAVE DONE A LITTLE MORE SHELL SEALING, BUT STOPPED DUE TO ESP.

* Testing with a DUCT BLASTER is required for DUCT Leakage Sealing. Testing with a BLOWER DOOR is required for SHELL Leakage Sealing.